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GLOSSARY OF TERMS RELATING TO PILE DRIVING EQUIPMENT

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GLOSSARY OF TERMS RELATING TO PILE DRIVING EQUIPMENT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 February 1972, after the draft finalized by the Construction Plant and Machinery Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard has been prepared with the object of unifying the various technical terms and expressions used in pile driving equipment and pile driving operations. While purporting to give the generally accepted meaning of the terms, the definitions should not be regarded as taking the place of a specification for pile driving equipment.

1. SCOPE

1.1 This glossary covers definitions of terms relating to pile driving equipment and pile driving operations.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Anvil — The part of a power operated hammer which receives the blow of the ram and transmits it to the pile.

2.2 Batter Pile or Raker Pile — A pile which is driven in an angle to the vertical, normally adopted to counteract horizontal force acting on vertical piles.

2.3 Bearing Pile — A pile driven or formed in the ground for transmitting the weight of a structure to the soil by the resistance developed at its point and by friction along its surface. It may be driven vertically or at an inclination (raker pile) and may be required to take uplift.

2.4 Boiler — The boilers are used for operation of winches and steam hammers. To ensure efficient hammer operation, the boiler should be quick steaming and with large evaporation capability so that it develops maximum power in the shortest possible time.

2.5 Bored Pile (Cast-in-Place Pile) — A pile formed with or without a casing, by excavating or boring a hole in the ground and subsequently filling it with plain or reinforced cement concrete.

2.6 Bouncing — The rebound of the hammer on hitting the pile. Too much bounce is a sign of inefficient driving as a large part of the energy is diverted from driving. Bouncing will nearly always occur as pile is near its desired set but bouncing in the beginning is an indication that hammer is too light for the task.

2.7 Brooming — Crushing and splaying of the fibre at the head of the pile. It acts as cushion and reduces the effect of hammer blow. To prevent this, a pile ring should be used.

2.8 Cast *in situ* Driven Pile — A driven (cast *in situ*) pile in which a light metal casing is driven into the ground with the help of a mandrel, and after the casing has reached the required depth, the mandrel is withdrawn leaving the casing in position to be filled with concrete.

2.9 Composite Pile — A pile whose length is made up of more than one material. Basically composite piles are divided into three classes:

a) Wood and concrete composite pile,

b) Steel and concrete composite pile, and

c) Wood and steel composite pile.

2.10 Dolly — A cushion consisting of a block of hardwood, plastic or other suitable material placed on top of the helmet to receive the blows of the hammer and to distribute it evenly over the surface of the helmet.

2.11 Driven Pile — A pile driven into the ground by the blows of a hammer.

2.12 Driven Cap — When steel sheet piling on other steel sections are driven with a drop hammer or single acting steam hammer, it is essential to protect the heads of the piles; cast steel driving caps shaped to suit the pile sections are used for this purpose. The caps are provided with a dolly of hardwood or plastic material.

2.13 Drop or Stroke — The distance through which the drop hammer is allowed to fall on to the helmet of the pile. The stroke or drop is the factor that determines the impact on energy delivered by the hammer.

2.14 Drop Hammer — A hammer (also called ram or monkey) raised by a winch and allowed to fall under gravity.

2.15 End Bearing Pile — Pile which transmits the load primarily by resistance developed at its toe.

2.16 Friction Pile — Pile which transmits the load primarily by friction developed along its surface. Friction pile in loose sand is sometimes called compaction pile.

2.17 False Leader — False leader consists of a pair of steel channels similar to leaders of a pile frame suitably braced and held together to form leader of pile. This is set on ground and held securely by guy ropes (*see* **2.25**).

2.18 Follower or Long Dolly — A member interposed between the head of the pile and the hammer when it becomes necessary to drive the head of the pile below the reach of the hammer. Follower shall be such that it transmits full impact of the hammer without undue deflection.

2.19 Helmet — A temporary cast steel cap, shaped to suit the pile, placed on the top of a pile being driven with a drop hammer or single acting hammer, to distribute the blow over the cross section and to prevent the head being damaged during driving.

2.20 Hanging Leader — Hanging leader consists of a pair of channels similar to the leader of a pile frame suspended from the jib of crane and positioned with the aid of adjustable strut. Hanging leaders are used in conjunction with cranes or mechanical excavators.

2.21 Jet — A stream of water or air and water applied under pressure from a pipe, used to facilitate the driving or lowering of pile into the soil by the dislodgement of the particles or by increasing the water content of soil to a point of fluidity.

2.22 Kinetic Energy of the Hammer — Kinetic energy of the hammer at bottom of stroke is:

$$\frac{WV^2}{2g} \text{ expressed in kgf·m}$$

where

W = weight of moving hammer in kg,

V = velocity in m/s, and

g = acceleration of gravity in m/s^2.

Energy is expressed in kgf·m. However, from the above expression, the losses due to the following shall have to be subtracted:

a) Efficiency;

b) Loss due to impact;

c) Loss due to temporary compression of pile, head and pile cap;

d) Loss due to temporary compression of pile; and

e) Loss due to temporary compression of soil.

Although same amount of energy may be produced by a light hammer with high velocity and with a heavy hammer with low velocity, it is preferable to use a hammer with a heavy weight and low velocity because the energy effective for driving the pile will be more in the later case.

2.23 Overdriving of Pile — Overdriving of pile usually occurs when a pile brings up quickly or being driven excessively hard so as to develop a greater load capacity. In overdriving, pile is damaged and value of pile as bearing member is affected.

2.24 Pile Extractor — A special machine or attachment for use with double acting hammers to loosen and extricate piles.

2.25 Pile Frame — A movable steel or timber structure for driving piles in the correct position and alignment by means of a hammer operating in the guides or ' leaders ' of the frame. Frames are mounted on swivelling travelling wheels usually fitted with jacking screws to level up on mounting.

2.26 Pile Ring — Pile ring is used to protect the head of timber pile. It consists of mild steel strap welded to form a ring. The head of the pile is then shaped to take the ring which is driven on with a heavy hammer.

2.27 Pile Shoe — Cast iron or cast steel shoe, fitted to the toe of timber or concrete pile to facilitate driving and to protect the pile as it is being driven.

2.28 Pile Rig — The complete pile driving equipment comprising of piling frame, leader, hammer, extractor winch and power unit. Complete pile driving rig may be mounted on rafts or pontoon or rails. Pile rig may also be a mobile unit mounted on trailers or trucks, or a special full revolving rig for raking piles.

2.29 Power Hammer — A self contained mechanism, having within itself the means of raising the hammer between blows. It rests on the head of the pile and is independent of any winch except for raising it into position. Power hammers are of following types:

a) *Single Acting Hammer* — A single acting hammer is a free falling weight called a ram which is lifted by steam or compressed air. When the ram reaches the top of the stroke, steam or air pressure is released and ram falls by gravity. The energy supplied is delivered by the heavy weight striking with low velocity.

b) *Double Acting Hammer* — It is steam or air hammer in which steam or air-pressure is used to lift the hammer and also to impart impact energy to the falling ram. Their action is faster than the single acting hammer. Since a part of the energy per blow is derived from the steam or air-pressure, the double acting hammer has a lighter ram than the single acting hammer for equally rated energy per blow. Also with a given weight of ram, it is possible to attain

a desired amount of energy per blow with a shorter stroke than with a single acting hammer.

c) *Differential Acting Hammer* — It is a short stroke fast acting hammer and combines the advantages of both the single acting and double acting hammers. The range of ram weight is same as for single acting hammer, while number of blows per minute approaches that of double acting hammer. The steam or air impart energy to the falling ram by applying steam or air-pressure on the head of the piston, but in this case the piston has two different diameters and the force of the steam or air added to the falling ram is the steam or pressure multiplied by the difference of the areas of the two pistons.

d) *Diesel Hammer* — This is a self-contained driving unit which does not require a steam boiler or air compressor. Diesel hammers weigh correspondingly less than steam hammer and depend on long drop. The ram is the cylinder of the hammer and is free falling. The air is compressed on the downward stroke of the ram working in the cylinder.

e) *Marine Hammer* — This is differential, double acting or single acting air or steam hammer totally enclosed for under-water operation.

2.30 Ram — The raising and falling part of the hammer which delivers the blow.

2.31 Set — The net distance through which the pile or the casing tube penetrates into the ground at each blow of the hammer.

2.32 Sheet Pile — Sheet piles are made from all basic pile material either plane or combined in a form or shape so that they interlock to form a wall or sheet of piling. The types are the following:

a) Wood sheet piling,

b) Concrete sheet piling, and

c) Steel sheet piling.

Sheet piling is used when a wall or sheet of piling is required, such as, in case of retaining walls, coffer dams and water front structure.

2.33 Springing — The lateral vibration of the pile that sometimes occurs at each blow of the hammer. It is caused by the head of the pile not being square to the hammer and if unchecked, will split the pile.

2.34 Test Pile — A pile which is selected for testing its load bearing capacity and which may be subsequently loaded for that purpose.

2.35 Uplift — This is resistance offered by the pile to extraction. This is particularly of importance where wind action is encountered.

2.36 Winch — A hoisting mechanism for lifting the hammer or the pile and consisting of a drum on which a rope or a cable is wound.. It may be operated by power or manually. Winches may be hand or power operated and are used for lifting of hammer and piles.